



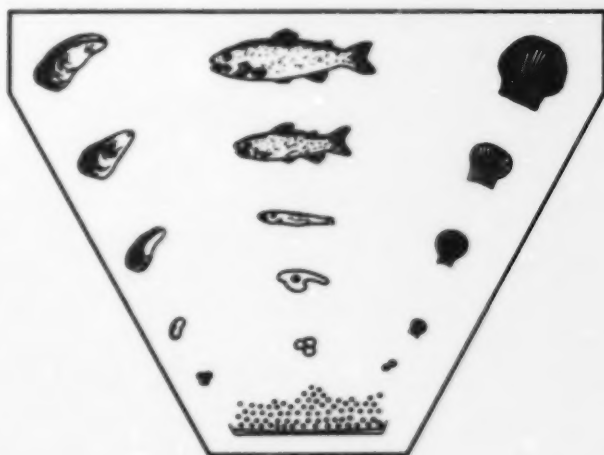
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF FISHERIES

AQUACULTURE METHODS

in

Newfoundland

(An Introduction)



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AQUACULTURE METHODS IN NEWFOUNDLAND
(An Introduction)

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Introduction

Aquaculture, the farming of marine and freshwater plants and animals, although responsible for 10 percent of the world's fishery production, is one of the relatively unexploited means of increasing food production in the Western world.

In Newfoundland, little interest has been expressed in aquaculture in the past due largely to abundant supplies of fish and other seafood. Recent stock reductions plus an increased demand for luxury seafood have prompted the private sector into considering certain aquaculture ventures, notably in scallop, mussel and salmonid culture.

Although the purpose of this paper is to provide information regarding species that have been cultured locally, it is not intended to be a "How to" manual nor the definitive work on aquaculture methods in Newfoundland.

The projects discussed in this paper deal with the cultivation of species to adult size rather than with enhancement, which is the production of young for release in the wild in order to increase common property resources. Most research into, and development of, local culture techniques have been carried out or financed by the Department of Fisheries and Oceans, and the Newfoundland Department of Fisheries. The federal effort is directed towards management and enhancement of resources which yields a common property fishery. The provincial interest has been in culture projects geared toward production by private enterprise.

Project Considerations

Site selection is one of the most important considerations in any aquaculture project as site conditions will determine the relative success of any venture. Information regarding such conditions should be taken periodically throughout the entire year and a collection of a minimum of two years' data is desirable in order to fully evaluate most sites. Information normally collected would include weekly water temperatures in the immediate culture site and salinities if the project is marine, along with water quality parameters related to pH, bacteria levels, and heavy metal contaminants. The relative shelter afforded by the site from storm or ice damage and the availability of seed or juvenile stages for culture are important considerations. An abundant supply of natural food or ingredients for preparing food must be on hand. Accessibility of the site from the point of view of servicing and protecting the operation from vandalism and the identification of prospective users of the site will do much to avoid future conflicts. This is a generalized list of factors which will help determine the potential for culture at a particular location. As most locations will not likely satisfy all criteria, judgment must be exercised as to which factors receive greatest priority.

Once the site and the culture organism have been selected the next important consideration is economics. Markets must be identified and ways of getting the product to those markets must be considered.

After this has been studied one final aspect must be considered. This deals with the various rules, regulations and permits required. The two main legislative bodies are the Provincial and Federal Governments and reference must be made to both to determine their requirements for recognition of a

culture site. For information dealing with Federal rules, regulations, licences or leases contact:

Mr. L. Riley,
Conservation and Protection Branch,
Department of Fisheries & Oceans,
P. O. Box 5667,
St. John's, Newfoundland

For information regarding Provincial regulations contact:

Dr. H. Squires
or Mr. D. Aggett
Provincial Department of Fisheries,
P. O. Box 4750,
Atlantic Place,
St. John's, Newfoundland.

Research and Development

This section deals with a brief overview of the research and development that has been conducted in Newfoundland on culture techniques. It must be pointed out that while many projects dealing with salmonid enhancement have been carried out by the Freshwater and Anadromous Fisheries Management Program group of the Department of Fisheries and Oceans those projects are not within the scope of this work and are not covered.

A: Historical overview

1. Rainbow trout

Aquaculture in Newfoundland has traceable roots to the end of the 19th century. On April 14, 1887, the Newfoundland Game Fish Protection Society Limited obtained a lease from the Crown to operate a fish hatchery at Upper Long Pond near St. John's. In 1895, this lease was extended to include the operation of a club house and dwellings at Murray's and Butler's Ponds for the purpose of breeding fish. In 1900, a wooden hatchery was erected at Murray's Pond which remained in operation until 1979 when extensive repairs became necessary. The hatchery is expected to reopen in 1982 after repairs, and refitting of the structure are completed.

The Murray's Pond operation dealt primarily with the culture of rainbow trout (*Salmo gairdneri* Richardson) for the purpose of stocking of the Society's ponds to provide recreational fishing for their members and to produce fry for stocking other ponds in the Province.

2: Cod and Lobster

In 1889 the Superintendent of Fisheries for Newfoundland, Adolph Nielsen, opened a cod and lobster hatchery on Dildo Island, Trinity Bay. It was the consensus at that time that recruitment to and recovery of depleted stocks could be increased by artificial propagation. The hatchery was designed primarily as a cod hatchery; consequently, by 1894, lobster propagation had been transferred from the hatchery to floating incubators which were located in the vicinity of the lobster-canning plants. It was the practice at this time to keep and process "berried females" and by hatching the fertile eggs in the floating incubators it was hoped that the larvae would survive and contribute to the lobster stocks. Vast numbers of larvae were released into the harbours and bays, but no quantitative work was carried out to see if any of them survived to increase the lobster population. In 1911, funding by the government was withdrawn.

3: Oysters

Oysters have been an important component of the North American fishery since the turn of the century. There has been a major fishery for oysters in the Maritime Provinces, but recently production has suffered major setbacks due to disease and over-fishing. Two unsuccessful attempts were made to introduce the American or cupped oyster (*Crassostrea virginica* Gmelin) to Newfoundland.

The first attempt was on the west coast and was reported by Dr. H. Thompson in 1930. The second effort was by the Fisheries Research Board of Canada — now called the Research and Resource Services of the Canada Department of Fisheries and Oceans — in a study that ran from 1965 to 1968 in three areas of the Island. One of these sites was monitored by the Biology Department of Memorial University of Newfoundland from 1965 to 1969. It was generally concluded that the temperatures of these culture sites were too low for reproduction although growth and fattening occurred.

The most recent attempt, utilizing the European flat oyster (*Ostrea edulis* L.), was started in the summer of 1972 by the Fisheries Research Board. Again, growth and survival rates were discouraging with high mortalities and low growth rates.

B: Recent Developments

1. MUSSEL CULTURE

a) Introduction

In the early 1970's, interest was expressed in the development of a blue mussel (*Mytilus edulis* L.) fishery. Surveys identified mussel beds as being widespread but commercially important in only a few areas. The small numbers of commercial beds and the promising results of spatfall trials combined to make the concept of local mussel culture attractive. A commercial pilot project was established in Garden Cove, Placentia Bay, in 1975. This was operated by the Marine Sciences Research Laboratory with assistance from the Industrial Development Branch of the Department of Fisheries and Oceans and the Newfoundland Department of Fisheries, until 1981 when it was transferred to the private sector.

b) About Mussels

Adult blue mussels in Newfoundland spawn from late June to late September when the water temperature ranges from 12° to 18°C. Eggs and sperm are shed into the water and mobile larvae result. After 20 to 35 days the larvae, now called spat, settle and attach to a substrate by means of byssal threads (their beard). This is known as spatfall. It was found for culture purposes that a spatfall density of 10 to 15 spat per centimetre of a 1.6 cm (5/8") diameter rope was the optimum level.

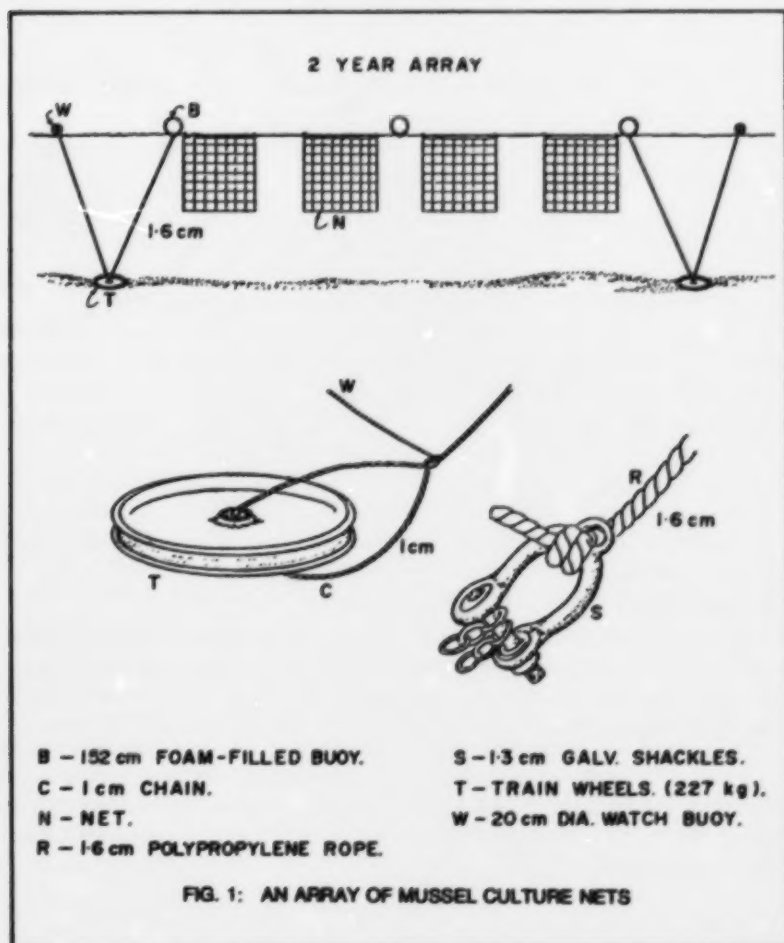
Mussels are fairly hardy and grow in a wide range of conditions, although mussels will tolerate subzero temperatures, growth is only possible in the temperature range of 3° to 25°C. The optimum temperature for growth, however, ranges from 10° to 20°C and growth above or below this range is slower. Salinities between 25 ppt. and 33 ppt. appear suitable for mussel culture but areas exposed to prolonged periods of reduced salinity (below 22 ppt.), or very rapid changes in salinity, should be avoided.

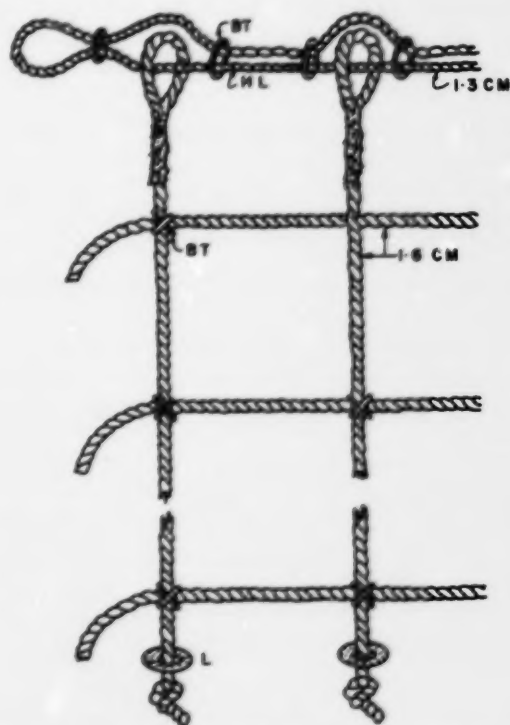
Mussels are filter feeders which means they get their food by straining small particles from the water in which they live. These small particles are known as plankton. Mussels cultured in areas receiving large amounts of domestic sewage or runoff from grazing animals can concentrate viruses and bacteria to such a level that the mussels are unfit for human consumption. If this is found to be the case, the culturist may be required by government to "depurate" the mussels. To do this the mussels are placed in an area of clean flowing water for a period of time until they have rid themselves of any deleterious matter.

c) Mussel Culture techniques used at Garden Cove

Information presented in this section summarizes the techniques developed at Garden Cove during pilot rearing trials from 1976 to 1980. For a complete account of the techniques tested consult Sutterlin, Aggett, Couturier, Scaplin, and Idler 1981: ("Mussel culture in Newfoundland Waters" MSRL Technical Report No. 22) prepared for the Industrial Development Branch of the Department of Fisheries and Oceans by the Marine Sciences Research Laboratory of Memorial University of Newfoundland.

Mussel culture commonly involves two main operations: spat collection and "grow out". Several types of collection and grow out methods were tried





BT - BLACK TARRED NYLON FOR LASHING JOINTS.
 HL - HEAD LINE.
 L - RING OR BARREL LEADS.

FIG. 2: CONSTRUCTION DETAILS OF A MUSSEL CULTURE NET.

FIG. REDRAWN FROM BUTTERLIN *et al.* (1981)

and suspended culture was eventually adopted whereby the same gear served as a settlement and grow out substrate.

The mussel culture array used at Garden Cove consisted of four nets attached to a buoyed headline anchored at both ends by 227 kg train wheels (Figure 1). Two different nets were tested at Garden Cove.

The first type, made of 1.6 cm (5/8") diameter polypropylene rope, has 10 horizontal and 10 vertical ropes arranged to form a 3m by 3m size net (Figure 2). The second type of net was machine constructed and was made of braided, doublestrand 4mm-diameter polypropylene twine which has a

stretch mesh of 30 cm (12"). Lead weights are attached to the bottom of both of these nets in order to keep them taut. Each net has its own head rope consisting of a continuous loop of rope with one half doubling over the top. This was then laced down upon itself with twine in order to keep the eyes of the net 30 cm (12") apart.

The nets were tied together by rope attached to each headline. Initially, the array was buoyed up by two polyurethane foam-filled floats of circumference 152 cm (60"), each capable of supporting approximately 91 kg of submerged weight. As the mussels grew and added weight to the nets more floats were added.

Spat settlement was found to occur from July to September with peak production in August. Nets were placed shortly before this peak so that they became properly conditioned for spat attachment.

To reduce winter storm and ice damage, the culture gear was sunk just below the surface of the water in December, by placing sandbags on the headline. During this time no appreciable growth occurred because of the low temperatures. The sandbags were removed in the spring, as soon as ice no longer posed a danger to the culture gear, so that the spring plankton bloom near the surface could be utilized as food by the mussels.

Low winter temperatures limited the local growing season to seven or eight months each year. This resulted in 30 to 35 months being needed at Garden Cove for the mussels to reach the marketable size of 5-6cm. Figure 3 depicts a three year production schedule similar to that practised at Garden Cove.

Harvesting was completed by mid-June prior to spawning. This ensured the greatest meat yield. In Garden Cove, nets were individually lifted to the afterdeck of a 13.7m(45') longliner by a hook extending from a Gilson boom. The weight of a single net averaged 180 kg, of which 150 kg were marketable mussels, yielding around 30 kg of steamed meats. This translates to a projected harvest after 3 years of about 15,000 kg/year obtained from the harvest of 25 arrays annually, if the proposed schedule in Figure 3 is followed.

d) Summary of Steps for Mussel Culture

In summary, the following steps are recommended;

- Select a suitable site.
- Obtain the necessary permits.
- Construct the spat collecting arrays of nets (Figure 1).
- Set arrays prior to peak spat settlement in August.
- Tie sandbags to headlines in late fall to sink gear below ice damage level during winter if ice damage is likely.

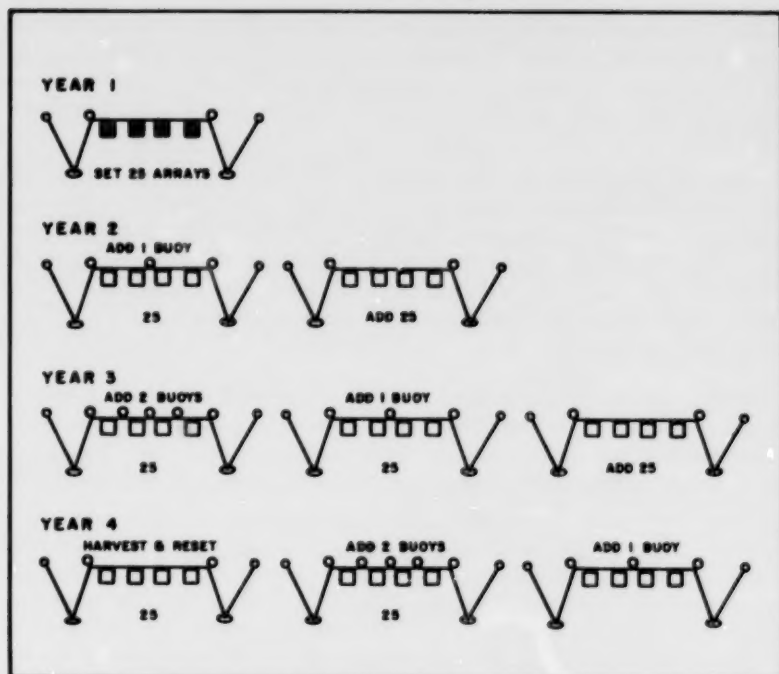


FIG. 3: THREE YEAR OPERATION SCHEDULE FOR MUSSEL CULTURE.

FIG. REDRAWN FROM SUTTERLIN *et al.* (1981)

- Resurface gear in early spring after the danger of ice damage is over.
- Carry on operations as indicated in Figure 3, attaching floats and setting additional gear.
- Harvest prior to spawning in May or early June of the third year.

2. SCALLOP CULTURE

a) Introduction

In 1971, the Newfoundland Department of Fisheries became involved with scallop aquaculture in a cost-shared project with their federal counterpart. Aquaculture technicians from Japan were hired to identify suitable areas for spat collection and "grow out". They were also responsible for the transfer of scallop aquaculture technology information to local groups.

Various areas were studied with Port au Port and Placentia Bays showing the most promise for commercial ventures. In 1973, it was decided to carry out a pilot commercial scale operation. For a variety of reasons Garden Cove and Little Bay, Mortier Bay, evolved as the pilot study areas. Spat were collected in both places, but Garden Cove was the only grow-out site.

In 1975 the Research and Resource Services Branch of the Federal Department of Fisheries and Oceans assisted with this project. The resulting field operations and research, biological and technical information as well as gear modification and improvement have produced better yields and reduced costs.

A number of problems were identified with Garden Cove as a holding facility so other sites were examined. Spencer's Cove, Placentia Bay was found to be a more suitable area for growth. By 1979, the holding facility in Garden Cove had been dismantled and a much smaller facility for growth and survival research was established at Spencer's Cove. Garden Cove, however, remains an important area for wild spat collection.

b) About scallops

Scallops are bivalves belonging to the group Mollusca. Locally, there are two species, the giant scallop (*Placopecten magellanicus* Gmelin) and the smaller Iceland scallop (*Chlamys islandica* Muller). Although the biological information provided here deals with the giant scallop, some of the information may also be valid for the Iceland scallop.

Sexes are generally separate in the giant scallop with both males and females occurring. Hermaphrodites (individuals which are both male and female) are rare. Gametes (eggs and sperm) are shed into the sea from August to October but a small amount of early spawning has been found in one area. Spawning appears to be triggered by the first sudden water temperature drop following the summer maximum in late August. This seems to be a mechanism which times the release of eggs and sperm so that chances of fertilization are increased. In years when this temperature drop is pronounced there is epidemic spawning resulting in large number of larvae. In years with unusual temperature regimes, as was the case in 1980, spawning occurs sporadically, resulting in reduced fertilization rates and lower number of larvae. The larvae of scallops are mobile and develop into spat. Spatfall (attachment of spat) occurs 40 to 45 days after spawning.

Scallops are a cold water species and grow well in a temperature range of 10° - 15° C. Temperatures of about 19° C are sublethal to the scallops and they will succumb to temperatures near 21° C. When the temperature falls below 10° C, growth rate slows down. At temperatures around 3.5° C growth is expected to stop. If scallops are subjected to these low temperatures, it will take longer for them to reach marketable size. Scallops are stenohaline (cannot withstand wide changes in salinity) and grow best in areas with salinities around 32 ppt. In areas with freshwater run-off where salinity drops below 32 ppt., scallops grow slowly or die. For these reasons sites for scallop culture must be selected so that there is little freshwater influence and temperatures do not exceed 20° C.

Scallops, like mussels, are filter feeders and as such usually require no supplemental feeding in culture. They filter plankton (microscopic plants and animals) from the water column.

c) Scallop culture

In Japan, where scallop culture was developed, a three-phase suspension culture technique is used and this was the method subsequently introduced here.

The first phase of the culture operation is spat collection. Artificial substrates for spat settlement (the best is 540 g of monofilament gillnet) are placed in onion bags (Figure 4).

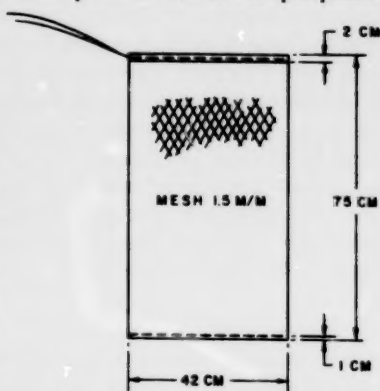
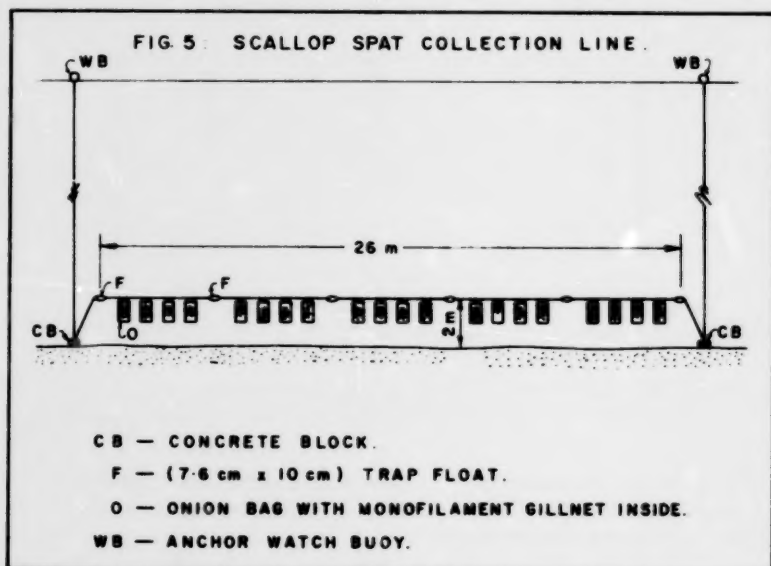


FIG. 4: ONION BAG

Twenty of these onion bags are tied to a 26m (85'), 1 cm ($\frac{3}{8}$ ") polypropylene rope which is anchored by concrete blocks and supported 2 m (6.5') off the bottom by six trap floats. This comprises one spat collecting line (Figure 5).

Peak spawning of scallops in the Little Bay area of Mortier Bay generally occurs after the first week in September. Delaying the setting of the collector gear until mid-late September reduces starfish (a predator) settlement and



increases survival of spat. The number of arrays to be set depends upon the scale of the culture operation and the spatfall densities in the local area. This gear may be refloated in May if conditions permit or may be left undisturbed until the following October when it is surfaced and the spat, which are now around 12 mm in size, are removed and placed into pearl nets — locally known as “blue bags” — for intermediate culture (Figure 6).

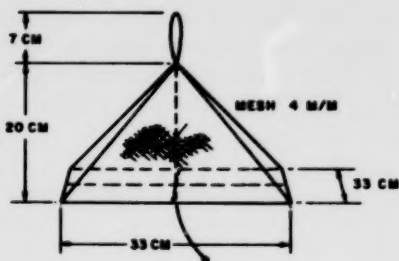
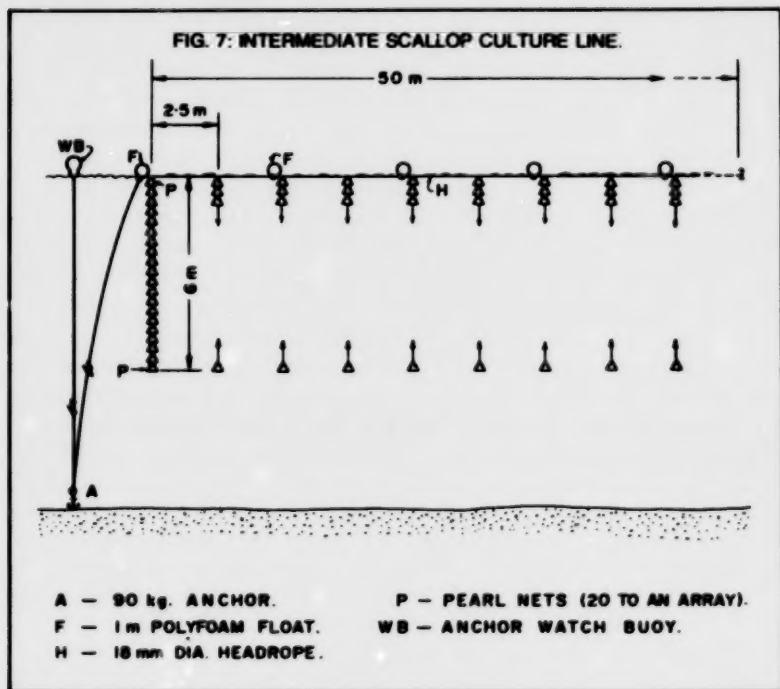
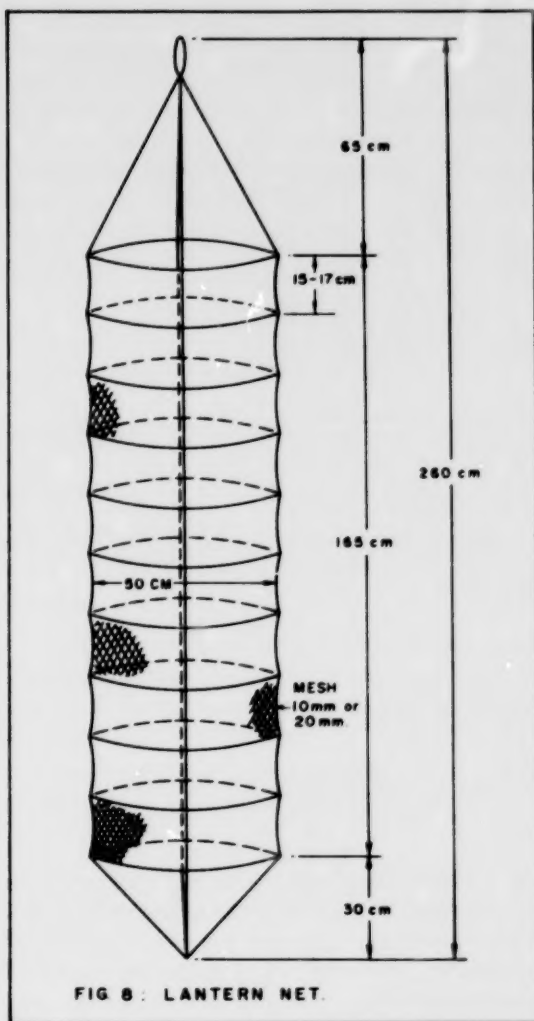


FIG. 6: PEARL NET OR “BLUE BAG”.

The normal stocking density of each pearl net is 50 spat. Generally, twenty pearl nets are attached together to form one array. Twenty arrays, containing a total of 400 pearl nets, are attached to a 50 m, 18mm diameter, polypropylene head rope which is supported by eleven 1 m (40") polyfoam single-eye buoys, and is anchored at both ends by a 90 kg (200 lb.) anchor (Figure 7). The number of pearl nets and the length of the head line are, of course, dependent upon the number of spat available and the local conditions of the culture site.





In late fall the headropes are weighted to sink the culture gear to a level that is safe from storm and ice conditions. In the spring the gear is resurfaced. Spat remain in the pearl nets for about a year until they are 40 to 60mm (about 1½ to 2½") in size. At this time they are ready for the third and final phase of scallop culture.

There are two methods considered for final culture. The first is called cage culture which involves placing the intermediate-size scallops into the various compartments of lantern nets — locally known as accordion nets (Figure 8) — and suspending them from a headrope.

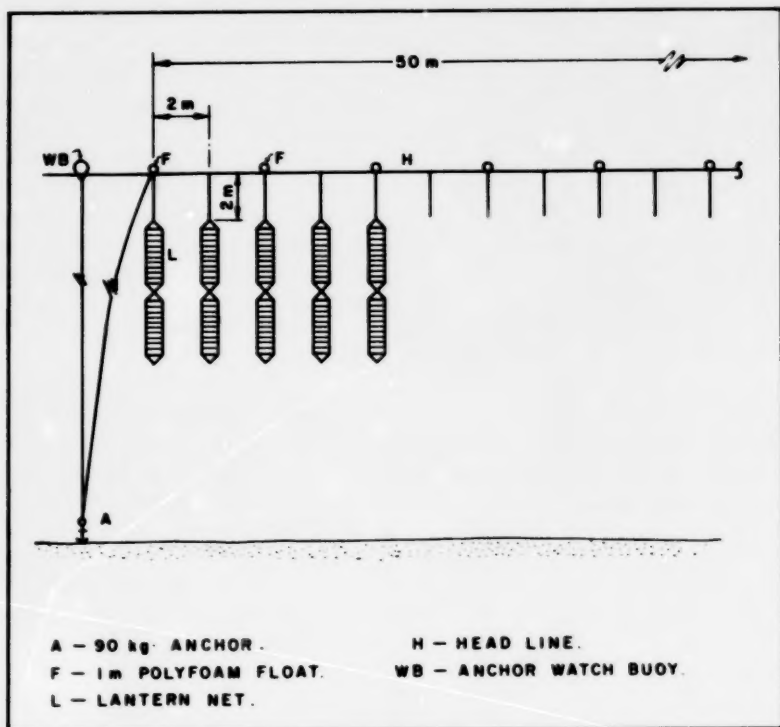


FIG 9 SCALLOP CAGE CULTURE LINE.

Each lantern net has 10 compartments and generally the initial stocking density is 20 scallops per level. Pairs of these lantern nets are attached by a 2m length of rope to a 50m (165') headrope which is anchored at both ends by 90 kg (200 lb.) anchors and is supported by eleven 1m (40") polyfoam single-eye buoys (Figure 9).

The headlines are submerged in the fall and are refloated the following spring. At this time the nets may need to be cleaned by a water jet. Stocking densities are reduced to 10 scallops per compartment with new lines being added to accommodate the scallops taken out. Harvesting would normally be carried out in the following year after the gear had been resurfaced.

Bottom culture is the second possible operation for final culture. In this method, scallops removed from intermediate culture are transplanted to the sea bottom in a suitable area and left to grow. Harvesting is normally one year later than with cage culture and would occur in the fifth summer of

operation. Harvest may be accomplished by dragging the bottom with a standard scallop drag or by having divers collect the scallops.

Locally, bottom culture has been found to be the most economically attractive method of scallop culture. It greatly reduces both capital expenditure for gear and labor costs, and has the added advantages of reduced navigational conflicts and vandalism opportunities. The disadvantages include a longer growth period and increased mortality.

A proposed schedule for the first five years of an operation is given in Figure 10 on page 22.

d) Summary of Scallop Culture Techniques

The techniques developed for scallop culture in Newfoundland are as follows:

- Select a suitable site.
- Obtain the necessary permits.
- Construct spat collection lines (Figure 5).
- Set lines in mid-September.
- During the spring, construct an intermediate culture line (Figure 7).
- Resurface the collection gear in the spring, or October, depending on conditions, and transfer the spat in October to the pearl nets. The stocking density is 50 spat per net.
- Weight headropes in the fall to sink the gear below the ice-damage level.
- Refurface the pearl nets and accordion trays in the spring after ice is no longer a threat.
- Transfer the scallops from the pearl nets when they are 40 to 60mm in size for final culture. This is usually done after one year in intermediate culture.
- Undertake final culture, using the bottom culture method or the cage culture method. Harvesting normally occurs during the fifth summer.

See Figure 10 in order to co-ordinate the various operations that must be done on a year to year basis.

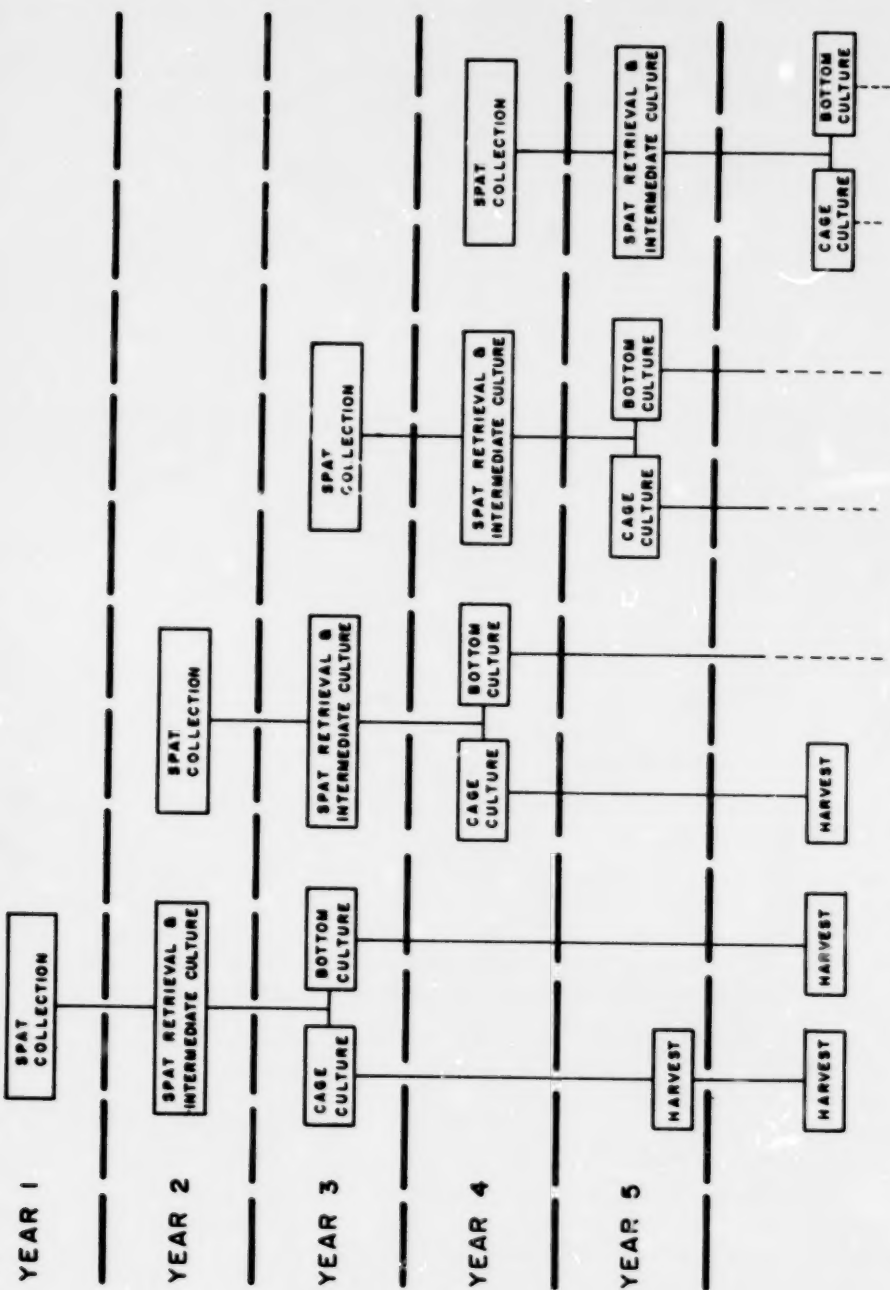


FIG. 10: FIVE YEAR OPERATION SCHEDULE FOR SCALLOP CULTURE.

ADAPTED FROM NAIDU et al. (1981)

3.

FISH CULTURE

a) Introduction

In Newfoundland fish culture has generated more interest and projects than the culture of any other group of aquatic animals. The federal fisheries group has been involved with salmonid research and spawning-area developments for enhancement purposes for many years. Recently, special interest groups have started projects to enhance salmon stocks. A privately-run rainbow trout hatchery has been operated for stocking purposes. There is a privately-run, commercial scale rainbow trout hatchery and marine farm being operated. There also have been a number of fish culture feasibility studies and experiments (such as the Holyrood flounder farm), some of which have been completed and some of which are still going on.

Many culture techniques have been developed, but only a few of them have been tested locally. Even though culture projects have been undertaken in Newfoundland for a long time, many of the techniques are still in the testing stage and much basic research is needed. For these reasons, a step by step approach for fish culture is not included in this paper. Instead, the purpose of this section is to give information about the range of projects currently being examined in the province.

b) Rainbow Trout

Currently rainbow trout (*Salmo gairdneri* Richardson) is the only fish being cultured on a commercial basis. Three culture methods are being used.

As previously mentioned, Newfoundland's first trout-rearing project is at Murray's Pond, where there is a hatchery which is currently closed for repair and refit. Here brood stock are stripped, eggs fertilized and hatched, and fry reared to the feeding stage. The hatchery employs a flow through system in which river water, flowing from Butler's to Murray's Pond, is pumped unheated to the hatchery. The fry are released into Murray's and Butler's Ponds in order to maintain the stocks for angling by members of Murray's Pond Club.

The second project is the rainbow trout hatchery and farm at Hopeall, Trinity Bay. This project was initiated and is presently operated by the Upper Trinity South regional Development Association. Planning for the project started in the fall of 1974 and received assistance from both the Federal and Provincial Governments. The preliminary objectives of this venture were to develop a broad stock from wild rainbow trout and to determine the economic and biological feasibility of locally rearing rainbow

trout from egg to a market size of approximately 225g (8 oz.) in eighteen months.

A three-year pilot scale project producing around 40,000 fingerlings annually was decided upon. It was thought that this would be a manageable scale, enabling the operators to develop culture skills and techniques, while at the same time being large enough to identify and correct any problems that might arise from a larger commercial operation. A detailed description of this operation is in Jamieson, A., 1978: "A Report on the Establishment and Operation (18 months) of a Rainbow Trout Hatchery / Farm at Hopeall, Trinity Bay, Newfoundland" published by the Freshwater and Anadromous Fisheries Management Program of the Research and Resource Services Branch of the Department of Fisheries and Oceans.

The water supply in use at Hopeall is a flow-through system. The eggs were stripped from the female brood stock in April and placed in a container and fertilized immediately with milt from the male. After rinsing, the eggs were "water hardened" for one hour, then placed in incubator trays to hatch. Hatching commenced in early June and the fish (alevins) remained in the trays until they began feeding. The fish were then transferred into plywood or fiberglass tanks where they remained until approximately 5cm (2") in length, at which stage they were placed into concrete raceways where they stayed for the remainder of the summer and winter.

In the pilot project two grow-out enclosures were compared: outdoor concrete raceways, and mesh cages floating in a brackish water pond.

The results of the cage culture showed that marketable size rainbow trout could be produced in a six-month growing season if one-year-old trout averaging 11.5g were stocked in early spring. This project is described in Jamieson, A., 1980: "The Cage Rearing of Rainbow Trout in a Brackish Water Pond in Newfoundland, 1978" published in a Canadian Industry report of Fisheries and Aquatic Sciences No. 115 by the Department of Fisheries and Oceans.

Except for the period immediately after hatching, the fish have to be fed. Initially, finely ground beef liver was added to condition the fry to begin feeding. After the fish had started to feed, small amounts of commercial feed were fed to them at half hour to hour intervals. The quantity and size of the feed was increased as the fish grew. During the second growing season, ground fish and fish offal were mixed in varying quantities with the dry commercial feed.

A third project is being undertaken by Mr. D. Pack of Kilbride. Using a style of aquaculture practised extensively in the Prairie Provinces, Mr. Pack is operating a "pot-hole" rainbow trout farm in a pond on his farm. Two hundred fry were provided by the Provincial Department of Fisheries in order to test growth and survival of trout in this system. The trout are to be overwintered in the pond and could weigh between 200-300g (7-10½ oz.)

next fall when they are harvested. This type of farming is carried out more for recreational uses than for commercial food production.

c) **Salmon**

In a project undertaken at Deer Island, N.B., from the winter of 1977 to the fall of 1979, the feasibility of marine cage culture of Atlantic salmon (*Salmo salar* L.) during an 18-month period was finally demonstrated. A detailed description of this project is in a 1981 report entitled "Salmonid Rearing Trials at Deer Island, N.B., With Some Projections on Economic Viability" published by the Department of Fisheries and Oceans in their Canadian Technical Report, Fisheries and Aquatic Sciences No. 1011. During the Deer Island trials, smolt, which weighed 60 to 80g (2 to 3 oz.) when initially placed in the cages, at harvest 18 months later weighed an average of 3.3 kg. (7 lbs.). The success of this venture in southern New Brunswick prompted investigation of existing environmental data for Newfoundland areas. After a preliminary review the south coast was identified as an area for further study.

The biggest difficulty facing culturists is finding cage culture sites at which winter water temperatures do not fall below -0.7°C , the temperature below which salmon cannot survive. Since the Atlantic Provinces' sea surface temperatures are often as low as -2.0°C , sites have to be selected with great care.

The Marine Sciences Research Laboratory received grants to look at the feasibility of establishing a hatchery using warm waste water from the Bay D'Espoir Hydro Electric Generating Station and to identify likely sites for cage rearing. A report on their findings was submitted to the Bay D'Espoir Development Association and the Newfoundland Department of Fisheries in July, 1980. Technically, the project is feasible; however, factors such as suitable and accessible marine cage-rearing sites with over-wintering capabilities, sources of funding and overall economic viability, in light of high capital investments, require more study before a decision to establish a hatchery can be made. Potential marine cage culture sites are now being studied and some trials at a number of sites (including Hermitage and Conne River) are being carried out.



1. Mussels

There is much interest in mussel culture with five projects being reported by the Provincial Department of Fisheries. The pilot scale mussel farm in Garden Cove is now under the management of Mr. Dave Walsh. The project has gone the normal progression from a small research project to a private venture. In Little Bay, Mortier Bay, Mr. Neil Farrell is augmenting his scallop culture project this season by setting out mussel collection equipment. Mr. Farrell intends to test a new spat collection substrate, called "vexar," from both longline and raft culture. Other projects have started at Connaigre Barachois, Hawke's Bay and Traytown, all dealing with experimental spatfall trials, the first step in establishing a culture operation.

2. Scallops

An interesting development occurred in 1978 with the collection of Iceland scallop spat from the artificial collectors. These have been retained and are in the Spencer's Cove facility for studies on growth and reproduction. It is believed that this is the first time that Iceland scallops have been collected from artificial substrates and grown out in captivity. Preliminary results of growth and survival are comparing favourably with that of the giant scallop; however, spatfall has been inconsistent. If spatfall information can be ascertained, then it is felt that this scallop may be important for local culture in the future.

There has been growing interest in scallop culture from the private sector. Mr. Neil Farrell is well into his second year of production of giant scallops in Little Bay, and a number of other proposals have been submitted to government for approval.

The Marine Sciences Research Laboratory of Memorial University of Newfoundland has received funding since 1972 to develop techniques for hatchery production of juvenile scallops. The hatchery project has progressed to the point where there are techniques now available to bring scallop spat up to the stage immediately before settlement. Research is ongoing in an effort to induce settlement of these stages.

Studies have been carried on in the Port au Port area since the early 1970's. In 1980 the Port au Port Economic Development Association became involved with scallop spat collection and culture for the purposes of enhancement. Spat collected from last year will be placed in pearl nets for one year of intermediate culture before being disseminated over the bottom. The spat collectors will be reset in order to provide more spat for intermediate culture next year.

3. Oysters

Site selection surveys of areas for sea pen culture of salmonids have identified certain areas which although unsuitable for fish culture may be ideal for other species. One such area is in the vicinity of Traytown where it is felt the conditions may be suitable for oyster farming. This area is now being studied and preliminary results are expected next year.

4. Eels

The Bay D'Espoir Development Association has recently received funding to carry out a feasibility study of eel fishing and farming in the Bay D'Espoir area. The project will examine the catch rates and size composition of the Bay D'Espoir eel stock and develop techniques for rearing undersized eels in earthen ponds to market size. The project is underway and catches of undersized eels have so far been successful.

5. Lobsters

Currently there are no plans to undertake any lobster culture projects in Newfoundland. A project underway in Victoria, P.E.I., which is culturing undersize lobsters from canner size to market, has demonstrated some degree of success. This project is funded in part by Labatt's Breweries and receives assistance from Fisheries and Oceans on diet and equipment development. In another project experiments are being conducted in attempts to rear adult lobsters from eggs produced in a hatchery.

6. Seaweed

The Marine Sciences Research Laboratory is presently carrying on research on the possibility of culturing a kelp, *Saccorhiza*, which can be used as food for human consumption, or as a source of chemicals for industrial purposes. Growth studies have been carried out and the results look quite promising. Presently, work on one developmental stage of its life cycle is going on. If this work is successful, then the technology for a large scale *Saccorhiza* farm will be available.

4

Information Sources

Available information sources:

In the Province the three main facilities which have carried out research and development and are available for advice, information and technical assistance on aspects of aquaculture are:

Organizations

1. The Dept. of Fisheries & Oceans
P. O. Box 5667
St. John's, Newfoundland
A1C 5X1
2. Provincial Dept. of Fisheries
P. O. Box 4750
Atlantic Place
St. John's, Newfoundland
3. Marine Sciences Research Laboratory
Memorial University of Nfld.
St. John's, Newfoundland

Some Contact Personnel

1. Scallops, mussels - K. S. Naidu
Research and Resource Services
 2. Salmonids - V. Pepper
F.A.F.M.P.
 3. Regulations - L. Riley
Conservation and Protection
-
1. Aquaculture (field assistance)
D. Aggett (regulations)
 2. Aquaculture (general) - Dr. H. Squires
 3. Aquaculture (development)-
H. Murphy
-
1. Mussels, Oysters - C. Couturier
 2. Salmonids - A. Sutterlin
 3. Seaweeds - Buggeln

In addition to these facilities there is written information available at:

1. The Henrietta Harvey Library
Memorial University of Newfoundland
St. John's, Newfoundland
A1B 3Y1
2. Northwest Atlantic Fisheries Center Library
Fisheries and Oceans
P. O. Box 5667,
White Hills
St. John's, Newfoundland
A1C 5X1
3. Arts and Culture Centre Library
St. John's, Newfoundland
4. Newfoundland and Labrador Development Corp Library
44 Torbay Rd.
St. John's, Newfoundland

Courses

There are two courses which may be of interest. The first is an Aquaculture Technicians Training Course which is held in St. Andrews, N.B., a joint venture of the Huntsman Marine Laboratory and the New Brunswick Community College with financing provided by Canada Employment Centers. This course has a four-month classroom component followed by a seven-month observation and apprenticeship portion in which candidates work on various projects in Atlantic Canada. For further information, write Huntsman Marine Laboratory, Brandy Cove, St. Andrews, New Brunswick.

The second course is a Mussel Farming course held at Montague, P.E.I., and is run by the Prince Edward Island Department of Fisheries. This course covers all aspects of mussel culture: site evaluation, production, transportation and marketing. For further information, write the Department of Fisheries, P. O. Box 2,000, Charlottetown, Prince Edward Island.

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